Synchronisation with the receiver is performed by sending null data until a synchronisation state is achieved 701, after which normal data can be sent over the link 702. The scheme is dependent on the fact that it is possible to detect an all zero data sequence before scrambling by testing the received sequence with the recurrence relation implied by the PRBS generator polynomial. The basis of the synchronisation scheme is co-operation between the two ends of the link, so that neither the synchronisation mini-cell nor any other mini-cell is transmitted unless the receiver at the same end indicates that its descrambler is in synchronisation. Essentially, the scrambler circuit performs a summation of the current bit sample with a running sum of previous samples occurring at integer multiples of n-bit offsets from the current sample to produce the scrambled output. The corresponding de-scrambler operates on the received signal to reverse the scrambling process by subtracting the current data sample from the previous data sample offset by the same n-bit positions.

In the state "Scrambler out of Sync Frame out of sync" 701 the receiver must detect at least one whole frame of null EOC traffic (no sync mini-cells) before entering the "Scrambler in sync" state 702.

In the Drawings

Please amend figures 2-7 as attached.

Remarks

In sections 2 and 3 of the Office Action, the Examiner objects to figure 2 because the reference character "232" is used to designate two distinct items and the reference character "223" does not appear. Figure 2 has been amended to more clearly distinguish the reference characters "232" and "223".

In section 4 of the Office Action, the Examiner objects to figures 3-7 as they do not contain reference numbers. Figures 3-7 and appropriate sections of the description have been amended.

In section 6 of the Office Action, the Examiner identifies a typographical error on page 10, line 8. The specification has been amended to address this.

In sections 7-11 of the Office Action, the Examiner rejects claims 2 and 6 as being indefinite. Claims 2 and 6 have been amended to address the Examiner's comments.

In section 24 of the Office Action, the Examiner states that claim 11 is allowed. Claim 7 has been amended to include the features of dependent claims 8-11 and claims 8-11 have been cancelled without prejudice. Claims 1, 2, 6, 12 and 13 have been amended to correspond with the amended claim 7.

Claim 3 has additionally been cancelled without prejudice and claim 4 has therefore been amended to change the dependence.

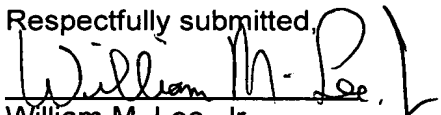
In sections 12-16 of the Office Action, the Examiner rejects claims 1, 7-9 and 12 under 35 U.S.C 102(e) as being anticipated by Achilleoudis. Independent claims 1, 7 and 12 have been amended to incorporate the features of the allowed claim 11 and reconsideration is therefore requested.

In sections 17-23 of the Office Action, the Examiner rejects claims 2-6, 10 and 13 under 35 U.S.C. 103(a). Independent claims 2, 6 and 13 have been amended to incorporate the features of the allowed claim 11 and reconsideration is therefore requested.

In view of the fact that all the Examiner's comments have been addressed, further and favorable consideration is respectfully submitted.

October 11, 2002

Respectfully submitted,



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Version With Markings Showing Amendments Made

Claims

1. (amended) Apparatus for providing a digital communication service over a line from a line termination equipment disposed at a central station to a subscriber terminal, wherein the line termination equipment and the subscriber terminal incorporate respective first and second management systems arranged to control and supervise said digital communication service via messaging therebetween carried in an engineering operations channel over the line, and wherein the line termination equipment and the subscriber terminal incorporate means for providing said engineering operations channel in the form of a sequence of asynchronous minicells over the line, wherein said engineering operations channel is framed and byte oriented and is scrambled over the line and wherein packet voice traffic is carried in spare capacity in said engineering operations channel, and wherein the line termination equipment and the subscriber terminal further comprise synchronisation means wherein the synchronisation occurs during a period of transmission of null data on said engineering operations channel.

2. (amended) A digital communications system, comprising a subscriber network termination, a line termination equipment, and a transmission path therebetween, the subscriber termination and the line termination being coupled to the path via respective first and second modems, wherein the subscriber termination and the line termination each incorporate respectively a first and second management system each system consisting of a corresponding plurality of management levels, said first and second management systems being arranged to control and supervise [said] a

digital communication service via messaging carried in an engineering operations channel over the [line] path, wherein said subscriber termination and the line termination each incorporate respective multiplexer means interfacing with the management levels of that termination, and wherein said subscriber termination and line termination incorporate respective packet transaction means each interfacing with the respective multiplexer means for carrying messaging between corresponding subscriber termination and line termination management levels in an engineering operations channel over the path [line], said engineering operations channel being comprised by a sequence of asynchronous minicells over the [line] path wherein said engineering operations channel is framed and byte oriented and wherein packet voice traffic is carried in spare capacity in said engineering operations channel, and wherein the line termination equipment and the subscriber terminal each further comprise

scrambling and descrambling means; and

synchronisation means wherein the synchronisation occurs during a period of transmission of null data on said engineering operations channel.

4. (amended) A digital communication system as claimed in claim [3] 2, wherein said line termination equipment is coupled to an ATM backplane whereby the digital service is delivered.

6. (amended) A digital subscriber network termination for receiving a digital service over a subscriber line coupled thereto, the subscriber termination including a management system consisting of a plurality of management levels, [said] a first and

a second management system being arranged to control and supervise said digital communication service via messaging carried in an engineering operations channel over the line, multiplexer means interfacing with the management levels of the subscriber termination, and packet transaction means interfacing with the multiplexer means for carrying messaging to and from the management levels in an engineering operations channel over the line, said engineering operations channel being comprised by a sequence of asynchronous minicells over the line wherein said engineering operations channel is framed and byte oriented and wherein packet voice traffic is carried in spare capacity in said engineering operations channel, and wherein the line termination equipment and the subscriber terminal each further comprise

scrambling and descrambling means; and

synchronisation means wherein the synchronisation occurs during a period of transmission of null data on said engineering operations channel.

7. (amended) A method of providing a digital communication service over a line from a line termination equipment disposed at a central station to a subscriber terminal, the method comprising

providing a engineering operations channel for effecting control and management of the subscriber terminal;

transporting said engineering operations channel in a sequence of asynchronous minicells over the line, wherein said engineering operations channel is framed and byte oriented and is scrambled over the line and wherein packet voice traffic is carried in spare capacity in said engineering operations channel; and

performing synchronisation between the central station and the subscriber terminal during a period of transmission of null data on said engineering operations channel.

12. (amended) A method of transporting digital traffic over a line from a central station to a subscriber terminal, the method comprising

providing an engineering operations channel over the line, wherein said engineering operations channel is transported over said line in asynchronous minicells and said engineering operations channel is framed and byte oriented and is scrambled over the line and wherein packet voice traffic is carried in spare capacity in said engineering operations channel; and

performing synchronisation between the central station and the subscriber terminal during a period of transmission of null data on said engineering operations channel.

13. (amended) A method of controlling digital communications system comprising a subscriber network termination, a line termination equipment, and a transmission path therebetween, the subscriber termination and the line termination each incorporating respectively a first and second management system each system consisting of a corresponding plurality of management levels, said first and second management systems being arranged to control and supervise said digital communication service, the method comprising

providing messaging paths between corresponding management levels; [and]

multiplexing said messaging paths into an engineering operations channel over the line, [and] wherein said engineering operations channel is transported in a sequence of asynchronous minicells over the line and said engineering operations channel is

framed and byte oriented and is scrambled over the line and wherein packet voice traffic is carried in spare capacity in said engineering operations channel; and performing synchronisation between the central station and the subscriber terminal during a period of transmission of null data on said engineering operations channel.

Specification

Page 8 line 25 – page 9 line 26:

In the arrangement of figures 1 and 2, traffic is transported over the subscriber loop in asynchronous minicells. The engineering operations channel (EOC) is framed and byte oriented, one EOC frame being equivalent to one line-code super-frame 301, the frame structure being illustrated in figure 3. The EOC channel contains a number information elements, these principally comprising a super-frame synchronisation pattern 302, generic indicator bits 303, transport protocol indicator bits 304 and EOC messages. The format of the EOC messages is that of the AAL2 common part sub-layer packets defined in the ITU draft recommendation I363.2 the content of which is incorporated herein by reference. The EOC message format further incorporates a special service specific convergence sub-layer defined for VDSL physical layer EOC applications.

The first byte of the EOC message field comprises a six bit pointer 305, a sequence number bit and parity bits. The pointer identifies the start of the first valid mini-cell in the EOC frame. The EOC message field is followed by minicells 306 which are packed into ATM cells as defined by the AAL2 protocol.

In a modification of the technique illustrated in Figure 4, the EOC synchronisation pattern is provided by the header of an AAL2 common port sublayer (CPS) packet with a special channel identifier (CID) 401 which contains as payload the indicator bits as defined above. In this embodiment, delineation of super-frame boundaries is based on the known super-frame length and consequently on the known periodic arrival of valid CPS-packet header error control (HEC) bits 402. Initial delineation may be implied by the link start-up process, or may be subsequently re-established by hunting for a number of correct HEC determinations and detection of the unique CID on predicted superframe boundaries. Further, loss of super-frame delineation may be detected by detection of a predetermined number of HEC failures in a given period. Control of the super-frame delineation process can be modelled on the state-machine used for ATM cell delineation.

Page 10 lines 6-20:

Any number of AAL2 CPS-packets may be included in a superframe, but padding bytes are inserted to ensure that superframe header synchronisation. Optionally network timing reference phase information can be carried in [he] the mini-cell where the transport system clock is not synchronised to an NTR.

Where the user terminal is provided with a register, this may be used to store command and control information. Access to the register may be effected via the messaging scheme illustrated in figure 5. The scheme includes register access

messages 501 to write information into and to read information from the register, and acknowledgement messages 502 which confirm to the exchange that a read and/or write instruction has been performed. The messaging scheme may also accommodate simple command messages that require no acknowledgement, e.g. a message reporting an imminent shut-down of transmission, by the use of a short message field 503. A further short message field 504 provides for the insertion of indicators as required.

Page 11 line 25 – page 12 line 2:

An alternative method for transporting Narrow-band traffic 602, 603 is by the use of circuit emulation in which an SSCS based ATM AAL1 with time stamps relies on transport of the NTR by the transport system(carried for example as a phase stamp in the synchronisation mini-cell); or by plesiochronous multiplexing of null encapsulated narrow band traffic with autonomous timing recovery. This is illustrated in figure 6a which refers to synchronous transport and figure 6b which refers to plesiochronous transport. For synchronous transport (figure 6a) the timing byte 601 is a signed integer giving the offset from the NTR phase. It is also possible to use two bytes each for the NTR phase and user timing phase.

Page 12 lines 14-34:

Synchronisation with the receiver is performed by sending null data until a synchronisation state is achieved 701, after which normal data can be sent over

the link 702. The scheme is dependent on the fact that it is possible to detect an all zero data sequence before scrambling by testing the received sequence with the recurrence relation implied by the PRBS generator polynomial. The basis of the synchronisation scheme is co-operation between the two ends of the link, so that neither the synchronisation mini-cell nor any other mini-cell is transmitted unless the receiver at the same end indicates that its descrambler is in synchronisation. Essentially, the scrambler circuit performs a summation of the current bit sample with a running sum of previous samples occurring at integer multiples of n-bit offsets from the current sample to produce the scrambled output. The corresponding de-scrambler operates on the received signal to reverse the scrambling process by subtracting the current data sample from the previous data sample offset by the same n-bit positions.

In the state "Scrambler out of Sync Frame out of sync" 701 the receiver must detect at least one whole frame of null EOC traffic (no sync mini-cells) before entering the "Scrambler in sync" state 702.